

REMARKS

Claims 1-10 were pending. Claims 1, 3, and 7 have been amended. Claim 11 has been added. Accordingly, claims 1-11 presently are pending.

Claims 3, 9, and 10 stand rejected under 35 U.S.C. § 112, second paragraph, on the basis of indefiniteness. Claim 3 has been amended as suggested by the Examiner. Claims 3, 9, and 10 are submitted as particularly pointing out and distinctly claiming the subject matter of the invention.

Claims 1, 6, and 7 stand rejected under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over U.S. Pat. No. 5,000,926 to Murayama et al. Applicant respectfully traverses this rejection. Amended claim 1 recites a process for the preparation of ammonia which includes contacting an ammonia synthesis gas with an ammonia synthesis catalyst arranged as a reaction zone in one or more catalyst tubes, cooling the reaction zone by a heat conducting relationship with a cooling agent, and withdrawing an ammonia rich effluent stream from the reaction zone. The cooling agent is selected from eutectic mixtures of potassium nitrate, sodium nitrate, and sodium nitrite, eutectic mixtures of sodium hydroxide and potassium hydroxide, and metals having a melting point below the temperature in the reaction zone. Amended claim 7 recites a converter for the preparation of ammonia having at least one catalyst tube adapted to receive ammonia synthesis gas and to hold a reaction zone of ammonia synthesis catalyst, and at least one cooling tube concentrically surrounding the at least one catalyst tube adapted to hold the cooling agent selected from eutectic mixtures of potassium nitrate, sodium nitrate, and sodium nitrite, eutectic mixtures of sodium hydroxide and potassium hydroxide, and metals having a melting point below the temperature in the reaction zone.

None of the references cited by the Examiner discloses the use of the recited cooling agents. Murayama et al. discloses the use of saturated pressurized water, oils and molten salts as cooling media.

Murayama et al. mentions in general catalyst layer-fixed reactors for exothermic reactions including methanol and ammonia synthesis. However, the detailed description solely refers to methanol synthesis, which requires a temperature of the cooling medium of 230-240° C (Table 1 in col. 5-6) as provided by pressurized water. The temperature of water is then controlled by controlling the pressure of water (col. 5, lines 23-27). Contrary to the above-known technique, the present invention as recited in amended claims 1 and 7 teaches temperature control by means of compositions not disclosed or suggested by Murayama et al. Independent claims 1 and 7 are not anticipated or rendered obvious by Murayama et al. Claim 6, dependent on claim 1, similarly is submitted as being patentable over the cited reference.

Claim 8 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama et al. Applicant traverses this rejection. Claim 8 depends from claim 7, and is submitted as being patentable over the cited reference.

Claims 2, 4, and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama et al. in view of U.S. Pat. No. 5,484,582 to Lee. Applicant traverses this rejection.

Claims 2, 4, and 5 depend from claim 1, which is submitted as being patentable over Murayama et al. Lee does not cure the deficiencies of Murayama et al. Lee has been cited as disclosing the use of multiple reaction zones and intermediate withdrawal of an ammonia effluent stream. Lee does not teach or suggest a process for the preparation of ammonia which includes cooling the reaction zone by a heat conducting relationship with a cooling agent selected from eutectic mixtures of potassium nitrate, sodium nitrate, and sodium nitrite, eutectic mixtures of sodium hydroxide and potassium hydroxide, and metals having a melting point below the temperature in the reaction zone. Claims 2, 4, and 5 are submitted as being patentable over the cited references to Murayama et al. and Lee.

Claims 3, 9, and 10 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Murayama et al. in view of either U.S. Pat. No. 5,032,364 to Pinto or U.S. 1,931,678 to Porter. Applicant traverses this rejection.

Claims 3, 9, and 10 depend from claim 1, which is submitted as being patentable over Murayama et al. Pinto and Porter do not cure the deficiencies of Murayama et al. Pinto and Porter have been cited as disclosing recycling a stream of unconverted ammonia synthesis gas to the reaction zone. Pinto and Porter do not teach or suggest a process for the preparation of ammonia which includes cooling the reaction zone by a heat conducting relationship with a cooling agent selected from eutectic mixtures of potassium nitrate, sodium nitrate, and sodium nitrite, eutectic mixtures of sodium hydroxide and potassium hydroxide, and metals having a melting point below the temperature in the reaction zone. Claims 3, 9, and 10 are submitted as being patentable over the cited references to Murayama et al., Pinto, and Porter.

New dependent claim 11 recites a process of claim 1 in which the step of contacting the ammonia synthesis gas takes place in a temperature range of between 300° C and 600° C. In addition to using a different cooling agent, a further major difference from the cooling process of Murayama et al. is that the process according to the invention is carried out at a higher temperature (about 300-600° C, page 4, 2nd paragraph). It is noted that water, as disclosed in Murayama et al., will not be a suitable choice as cooling agent. In order to maintain water in the liquid phase at typical reaction temperatures, water will have to be maintained at a high pressure, which requires expensive compression energy. Furthermore, water will poison and destroy the ammonia catalyst in case of a leakage. Claim 11 is submitted as being patentable over the cited references.

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In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

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Respectfully submitted,

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